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In Situ Chemical Composition Measurements of Planetary Surfaces with a Laser Ablation Mass Spectrometer

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The knowledge of the chemical composition of moons, comets, asteroids or other planetary bodies is of particular importance for the investigation of the origin and evolution of the Solar System. For cosmochemistry, the elemental and isotopic composition of the surface material is essential information to investigate origin, differentiation and evolution processes of the body and therefore the history of our Solar System [1]. We show that the use of laser-based mass spectrometers is essential in such research because of their high sensitivity in the ppm range and their capability for quantitative elemental and isotopic analysis.
A miniaturised Laser Ablation Time-of-Flight Mass Spectrometer (LMS) was developed in our group to study the elemental composition of solid samples [2]. The instrument's small size and light weight make it suitable for an application on a space mission to determine the elemental composition of a planetary surface for example [3].
Meteorites offer the excellent possibility to study extraterrestrial material in the laboratory. To demonstrate the sensitivity and functionality of the LMS instrument, a sample of the Allende meteorite has been investigated with a high spatial resolution. The LMS measurements allowed investigations of the elemental abundances in the Allende meteorite and detailed studies of the mineralogy and volatility [4]. These approaches can be of considerable interest for in situ investigation of grains and inhomogeneous materials with high sensitivity on a planetary surface.

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